11.1 Mathematical Patterns
Algebra 2B

Name_____
Date_____ **Per**_____

Arithmetic: the **difference** between consecutive terms is constant (common difference ***d***).
Geometrc: the **ratio** between consecutive terms is constant (common ratio **r**).

Recursive Formula: defines the terms in a sequence by relating each term to the term before it.
For example: **Arithmetic:** $a_n = a_{n-1} + d$ **Geometric:** $a_n = a_{n-1} \bullet r$
→To find a specific term given the recursive formula, you must be given the previous term.

Explicit Formula: defines the ***nth*** term in terms of ***n***.
For example: **Arithmetic:** $a_n = a_1 + (n-1)d$ **Geometric:** $a_n = a_1 \bullet r^{n-1}$

Ex. #1 Find the first 5 term of the sequence (recursive):

a) $a_n = a_{n-1} - 6; a_1 = 12$

12, 6, 0, -6, -12

b) $a_n = \frac{1}{3}a_{n-1}; a_1 = 12$

$12, 4, \frac{4}{3}, \frac{4}{9}, \frac{4}{27}$

Ex. #2 Find the first 5 terms of the sequence (explicit):

a) $a_n = 3n - 1$

2, 5, 8, 11, 14

b) $a_n = n(n-1)$

0, 2, 6, 12, 20

Ex. #3 Describe the following sequences as arithmetic, geometric, or neither. Then, write the recursive and explicit formula for each:

a) 4,8,12,16,... Arithmetic

Recursive: $a_n = a_{n-1} + 4$, $a_1 = 4$

Explicit: $a_n = 4 + (n-1)4$, $a_n = 4n$

b) 16,8,4,2... Geometric

R: $a_1 = 16$, $a_n = \frac{a_{n-1}}{2}$

E: $a_n = 16\left(\frac{1}{2}\right)^{n-1}$

c) 4,9,16,25,... Neither

R: $a_1 = 4$, $a_n = \left(\sqrt{a_{n-1}} + 1\right)^2$

E: $a_n = (n+1)^2$

d) −1,1,−1,1,... Geometric

R: $a_1 = -1$, $a_n = a_{n-1}(-1)$

E: $a_n = (-1)^n$

Classify each sequence as arithmetic, geometric, or neither. Then, find the next two terms:

1. 80,77,74,71,68,... A

65, 62

2. 4,8,16,32,64,... G

128, 256

3. 1,2,6,24,120,... N

720, 5040

4. 100,10,1,0.1,0.01,... G

.001, .0001

5. $\frac{1}{2},\frac{1}{4},\frac{1}{8},\frac{1}{16},\frac{1}{32},\ldots$ G

$\frac{1}{64}$, $\frac{1}{128}$

6. $0,1,0,\frac{1}{3},0,\frac{1}{5},\ldots$ N

0, $\frac{1}{7}$

Write a recursive formula for each sequence. Then, find the next term:

7. 43,41,39,37,35,...

$a_1 = 43$
$a_n = a_{n-1} - 2$
(33)

8. 6,1,–4,–9,...

$a_1 = 6$
$a_n = a_{n-1} - 5$
(-14)

9. $144,36,9,\frac{9}{4},\ldots$

$a_1 = 144$
$a_n = \frac{1}{4} a_{n-1}$
($\frac{9}{16}$)

Write an explicit formula for each sequence. Then, find the next term:

10. 4,5,6,7,8,...

$a_n = 4 + (n-1)$
(9)
$a_n = 3+n$

11. $\frac{1}{2},\frac{1}{4},\frac{1}{8},\frac{1}{16},\frac{1}{32},\ldots$

$a_n = \left(\frac{1}{2}\right)^n$
($\frac{1}{64}$)

12. 2,5,10,17,26,...

$a_n = n^2 + 1$
(37)

Decide whether each formula is *explicit* or *recursive*. Then, find the first four terms:

13. $a_n = 2a_{n-1} + 3; a_1 = 3$

R

3, 9, 21, 45

14. $a_n = (n-5)(n+5)$

E

$n^2 - 25$

-24, -21, -16, -9

15. $a_n = \frac{1}{2}n(n-1)$

E

0, 1, 3, 6

16. $a_n = a_{n-1} - 17; a_1 = 340$

R

340, 323, 306, 289

17. $a_n = 2n^2 + 1$

E

3, 9, 19, 33

18. $a_n = \frac{1}{2}a_{n-1}; a_1 = -4$

R

-4, -2, -1, $-\frac{1}{2}$

Find the next two terms in the sequence. Then, write a recursive *or* explicit formula for the *nth* term. Identify each formula as *recursive* or *explicit*.

19. 5,8,11,14,17,...

20, 23

R $a_n = a_{n-1} + 3$, $a_1 = 5$

20. 1,8,27,64,125,...

216, 343

E $a_n = n^3$

21. 49,64,81,100,121,...

144, 169

E $a_n = (n+6)^2$